LOG OF MEETING

DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Status of Various CPSC Flammability Projects

DATE OF MEETING: September 3, 1997

DATE OF LOG ENTRY: September 8, 1997

SOURCE OF LOG ENTRY: Margaret L. Neily, ESME

LOCATION: American Textile Manufacturers Institute, 1130 Conn. Avenue, Washington, DC

CPSC ATTENDEES: Dale Ray, EC, James Hoebel and Margaret Neily, ESME

NON-CPSC ATTENDEES: See attached list of attendees.

SUMMARY OF MEETING: This was a joint meeting of the Flammability Committees of the American Textile Manufacturers Institute (ATMI) and the American Fiber Manufacturers Association (AFMA).

Mr. Ray presented an update of CPSC staff activities on upholstered furniture flammability, including the status of technical work and an upcoming briefing package. The package, containing the staff's conclusions and recommendations for action regarding both small open flame and cigarette ignition hazards, is expected to be available to the public by the end of September 1997. Mr. Ray responded to a number of questions about the content of the upcoming briefing package and about the process for and timing of Commission consideration of options.

Mr. Hoebel reviewed the status of the CPSC mattress/bedding fires project. The project involved the analysis of fire data, both national estimates and in-depth investigations, to help determine a) if a mattress open-flame standard would be appropriate and b) why the continues to be an appreciable number of cigarette-ignited mattress fires and deaths in spite of the 1973 mandatory standard requiring cigarette resistant mattresses. The study found that while the number of cigarette-ignited fire deaths have been reduced since 1980, the number of open-flame ignited fire deaths remain constant. Bedding was the first item ignited in open flame fires more often than mattresses. The recent CPSC standard requiring child-resistant cigarette lighters is expected to reduce some of these open-flame related deaths, but an appreciable number are expected to continue. CPSC staff plans to determine whether a sample of retail blankets complies with an existing ASTM blanket flammability voluntary standard. It appears that post-standard mattresses that are expected to resist cigarette ignition are involved in some recent fires. Copies of the May 1997 report *Residential Fires in Mattresses and Bedding* were provided. The staff plans to evaluate another field

study now being conducted by the National Association of State Fire Marshals before considering future actions.

Ms. Neily reviewed the status of several apparel flammability projects. The Commission recently amended Children's Sleepwear Standards to allow non-FR sleepwear garments to be sold if they meet specific dimensions making them "tight-fitting." The staff is seeking industry input on several potential clarifying amendments that deal mostly with where to make required garment measurements. These "technical" amendments would **not** change the dimensions, thereby making the garments looser-fitting. The staff is also developing a structured demonstration with children to show the level of practicality of various garments that are (could be) made under the current provisions or clarifying amendments. A briefing package for the Commission is planned for December 1997.

Another project involves the updating of home laundering procedures and detergents referenced by the sleepwear, mattress, and carpet & rug flammability standards. AATCC 124-1996 (the laundering method referenced) has been updated to include new equipment, and, possibly more significantly, non-phosphate-built detergent. The staff is drafting an Advance Notice of Proposed Rulemaking (ANPR) for Commission consideration. The briefing materials will include results of staff tests comparing performance of flame resistant sleepwear fabrics tested by the current and new AATCC methods. Fabrics treated with a common phosphorous-based flame retardant produced 10 inch char lengths after washing with non-phosphate **powder** detergents (AATCC 193 and commercial detergents). A briefing package is planned for early 1998.

The staff is also developing an ANPR to update the Standard for the Flammability of Clothing Textiles, originally issued in 1953. Refurbishing methods (laundering and dry cleaning) require modernizing because they are no longer used or violate environmental laws. Clarifications are needed for certain testing procedures and interpretation of test results. To the extent practical, these changes will be coordinated with the Canadian government in the interest of harmonziation. A briefing package is planned for the Commission by mid 1998.

RESIDENTIAL FIRES IN

MATTRESSES AND BEDDING

JULY 1996

REVISED MAY 1997

Manon A. Boudreault, M.P.H.
Linda E. Smith
Hazard Analysis Division
Directorate for Epidemiology and Health Sciences
U.S. Consumer Product Safety Commission
Washington, DC 20207

CONTENTS

Executive Summary

In spite of the 1973 Federal standard enacted to reduce mattress fires ignited by cigarettes, fires in which mattresses and bedding were the first items to ignite continue to be a major cause of U.S. fire deaths. The purpose of this study was to examine the factors involved in ignition of mattresses and bedding, and identify trends in bedding/mattress fires and fire losses. National fire data were evaluated to provide an overall picture of the magnitude of the problem. Investigations of fire incidents were conducted by U.S. Consumer Product Safety Commission (CPSC) field staff to provide more specific details of the interrelated factors involved.

The following national estimates are based on data from the U.S. Fire Administration and the National Fire Protection Association:

- Mattress/bedding fires remain one of the major causes of residential structure fire deaths. Mattresses or bedding items were the first items ignited in an estimated 31,300 residential structure fires in 1993. These fires resulted in an estimated 610 civilian deaths, 3,540 civilian injuries, and $385.2 million in property loss.

- The greatest proportion (42%) of mattress and bedding fires in 1993 was due to ignition by open flame products (e.g., lighters, matches), an estimated 13,150 fires that resulted in 190 deaths (31% of total deaths). Of these open flame fires, children playing accounted for about 9,200 fires and about 180 deaths (30% of the total fires and deaths and 95% of deaths from open flame fires). Child play was involved in 83 percent of the 150 deaths of children less than 5 years of age.

- Compared to open flame fires, mattress/bedding fires ignited by smoking materials (primarily cigarettes) constituted a smaller number of fires, 9,300 (30%), but a larger number of deaths, 340 (55%). Smoking material-ignited fires were more likely to result in a casualty. Most fire deaths occurred when smoking materials were discarded or the smoker/victim was asleep when the fire occurred.

- A review of trends showed a significant downward trend in mattress/bedding fires and deaths between 1980 and 1993. The reduction primarily was due to fewer fires ignited by smoking materials. Deaths from open flame-ignited mattress/bedding fires did not indicate a significant downward trend since 1980.

- Deaths per 1,000 fires ignited by both smoking materials and open flame products have increased over time. In smoking material fires, there were 18.8 deaths per 1,000 fires in 1980 compared to 36.6 deaths in 1993. In open flame fires, there were 11.9 deaths per 1,000 fires in 1980 compared to 14.7 in 1993.

The following results are based on 156 mattress/bedding fires investigated by CPSC field staff between October 1994 and December 1995:

- Bedding reportedly was the first item ignited in 67 percent of the mattress/bedding fires.

- There appeared to be six cases in the CPSC study where a cigarette ignited a post-standard mattress (which should have resisted cigarette ignition). In one case, the mattress was described as having been "reconditioned." Another was described as a futon.

- In 31 cases, 45% of the open flame fires, the fire was started by a child less than 5 years of age playing with a lighter, the segment of fires expected to be reduced by the 1994 cigarette lighter standard. In six of these cases, the lighter was believed to be marketed as a child-resistant lighter (in one of these, an adult had modified the lighter so that the child-resistant feature was no longer active).

Further reductions in smoking material ignition of mattresses may occur with continued replacement of pre-standard mattresses with post-standard mattresses. However, the degree of involvement of bedding as the first material ignited in mattress/bedding fires remains a complicating factor. To the extent that bedding ignited first, the potential for future reductions in mattress fires could be affected, since the 1973 mattress standard was not designed to prevent mattress ignition by already flaming items such as bedding.

The Federal standard requiring child-resistant cigarette lighters took effect just before this data collection study began in 1994. As post-standard lighters become more prevalent, open flame ignitions of both mattresses and bedding caused by children under 5 years of age playing with lighters may be reduced. However, child play fires involving matches and candles, and lighter fires caused by older children, can be expected to continue. A study to evaluate the effectiveness of the child-resistant lighter standard is scheduled to begin in October 1997.

CPSC Flammability Briefing
ATMI Office
Washington, DC
September 3, 1997 – 2:00 p.m.

Name	Company	E-Mail	Phone
Jean Krasny	ret'd. fr. NIST	—	301-564-0342
John Torrance	Allied Signal		(804) 717-2794
Sam Cristy	Product Safety Letter	wbil@erols.com	703/247-3423
Bill Kethrick	Cotton Inc/Cotton Inc	BREARICK@COTTON.INC.COM	919-510-6234
Richard Nigro	Mt Vernon Mills	—	800-845-3251
Patty Adair	NCC	padair@cotton.org	202-745-7805
P. Wakelyn	NCC	pwakelyn@cotton.org	202 745 7805
Jos Vanderhaas	Celanese	JVANDERM@WPO.HCI.COM	704 554 3497
Laurel Berkin	Crown Crafts	—	770 644 6262
Harley Poole	ATMI	hpoole@atmi.org	202-862-0079
Jennifer Brown	Quaker Fabrics		508 646-2545
Tom Novak	Guilford Mills Inc	tom.novak@gmills.com	910 316 4381
John W. Michener	Milliken	jmichener@aol.com	864 574 9804
Brad Martin	Burlington Ind	Martindar@juno.com	910-228-2674

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ATMI Office
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September 3, 1997 – 2:00 p.m.

Name	Company	E-Mail	Phone
BRUCE Holzschuh	WESTPOINT STEVENS		334 742-2275
Phil Stricklen	Amoco Fabrics and Fibers	pms06@AOL.com pmstricklen@Amoco.com	(770) 944-4704
KAY VILLA	ATMI	kvilla@atmi.org	(202) 862-0500
BOB BARKER	AFMA	bbarker@atma.org	202-296-6508
Margaret Neily	CPSC/Engineering	info@cpsc.gov mention my name in the message	(301) 504-0550 x 2354
Dale Ray	CPSC/Economics	"	(301) 504-0962
James F. Hoebel	CPSC/Engineering	"	301 504-0494 x 1380
Herman H. Forsten	DuPont AFS		302-999-2697
Tony Shaw	Hoechst Corp.	75364.205@ Compuserve.com	202-296-2890
Bruce Navarro	Navarro Legislative/ Regulatory Affairs	nlra@erols.com	202-955-6006
SALMAN CHAUDHRY	WEAVE CORP.		(717) 336-7577
[illegible]	[illegible]		717 336-7577
Catherine Morin	Wester Inc	morin asc@skipjack.bluecrab.org	410-810-1877
Julie Johnston	Albright & Wilson	JJOHNSTON@ ALBRIGHT-WILSON.COM	804-968-6585

CPSC Flammability Briefing
ATMI Office
Washington, DC
September 3, 1997 – 2:00 p.m.

Name	Company	E-Mail	Phone
Debi Q Richardson	SPI	drichard@spcpas.org	202/974-5304
Sheila A. Millar	SPI / Keller and Heckman LLP	millar@khlaw.com	202/434-4143
William Hamlet	ATMI		

U.S. CONSUMER PRODUCT SAFETY COMMISSION

Activities on Upholstered Furniture Flammability

September 3, 1997

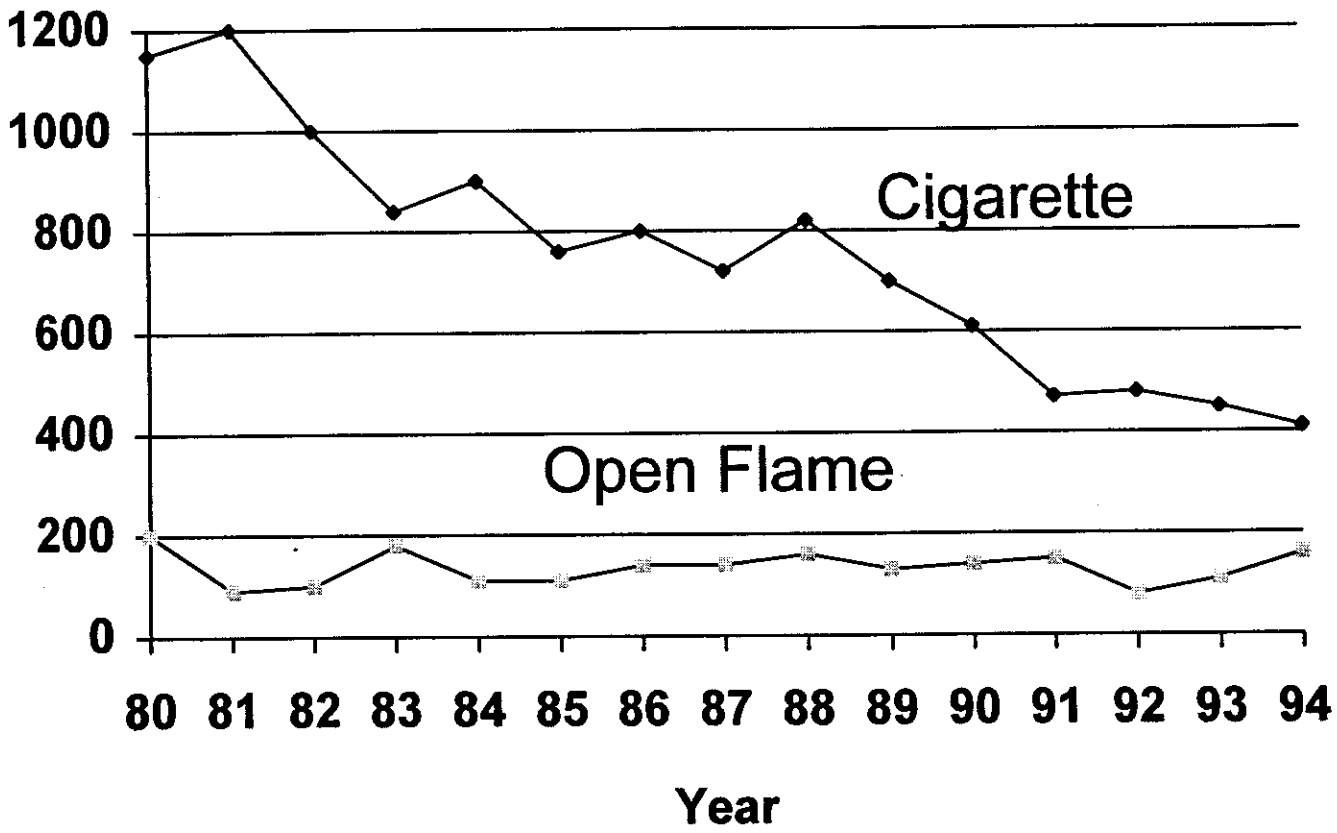
Dale R. Ray, Project Manager

(301) 504-0962

Overview

- NASFM Petition
- Standards Development: Small Open Flame Ignition
- Performance/Conformance Evaluation: Cigarette Ignition

Upholstered Furniture Fire Deaths 1980-1994



Open Flame Fire Losses

- 1990-1994: annual average of 130 deaths, 530 injuries, $60 million property damage
- No significant decline since 1980
- CPSC lighter rule to prevent some but not all losses
- Small flame ignitions: lighters, matches, candles

Small Open Flame Fire Losses

	Small Open Flame Losses* 1990-94	Avg. % total Open Flame 1990-94
Fires	3,100	82
Deaths	100	77
Injuries	460	87
Prop. Damage	$50m	80

*Ignitions of upholstered furniture by matches, lighters & candles

ANPR -- June 1994

- Small Open Flame ignited furniture fires may present unreasonable risk
- CPSC staff to develop possible standard; alternatives solicited
- No commitment to mandatory rule

ANPR Responses

- Fire hazard data
- Standards justification
- Laboratory testing issues
- Economic impacts
- FR chemical toxicity
- Voluntary alternatives

CPSC Options

- No action (withdraw ANPR)
- Defer to voluntary action
- Propose labeling rule
- Propose performance rule
  - »Fabrics, components or finished products

Commenters' Suggestions

- Voluntary std. / Mandatory std.
- Adopt TB-117 / BS-5852 / CEN1021-2
- Ignition resistance / Heat release
- Full scale tests / bench scale tests
- Composite tests / component tests
- FR foams / FR upholstery materials

AFMA/ATMI Recommendations

- Define hazard, products, occupancies
- Demonstrate risk with fire data
- Consider UFAC voluntary program addressing largest hazard
- Do not mandate Cal TB-117
- Consider & avoid offsetting risks
- Seek lower ignition propensity cigarettes

CPSC Small Open Flame Activities

- Fire Investigation Study
- Laboratory Testing
- Standards Development & Analysis

Fire Investigation Study

- Ignitions of upholstered furniture by lighters, matches or candles
- Ignition locations & scenarios
- 76 in-scope fire investigations 10/94-2/97

CPSC Laboratory Tests-- Small Open Flame

- Full Scale: UFAC, California, British
- Bench Scale:
  - » Composites
  - » Fabrics
  - » Test Fixture Evaluations
  - » Temperature Measurements
  - » Relation to Cigarette Ignition

CPSC Laboratory Tests -- Small Open Flame

- Most conventional materials ignite
  - » Upholstery materials
  - » Interior materials above dust cover
- FR Foams & inert barriers may limit fire growth but not prevent upholstery ignition
- Some FR fabrics & barriers may prevent ignition and fire growth

Existing Approaches -- Small Flame Resistance

- FR Filling Materials
  - » Treated
  - » CMHR
- Fire Barriers
  - » Interliners
  - » Laminates
- FR Upholstery Materials
  - » Inherent
  - » Treated

Draft CPSC Standard

- Seating furniture: upholstery + filling material
- Home or other consumer use
- Primary small open flame ignition locations
- Performance requirements/ bench scale tests

Effect on Cigarette Ignition

- Small open flame ignition resistance: impact on cigarette ignition resistance
- Beneficial vs. adverse impacts

Statutory Considerations

- Nature of risk
- Technical feasibility
- Cost & benefits
- Existing standards

Cigarette Evaluation

- Ignitability of Currently-Manufactured Furniture
- Conformance to UFAC Performance Criteria

CPSC Lab Tests -- Cigarette Ignition

- Product ignitability estimates based on full scale test results + mfrs survey data
- Industry conformance, based on UFAC component tests, & relation to full scale ignition resistance
- Small % furniture ⇨ Large % fires

Statutory Considerations

- Significant, addressable risk? Potential for further fire loss reductions?
- Voluntary program adequate?
- Standard or other action feasible? Potential impact on costs, choice?

CPSC Decision Schedule

- Staff Briefing Package (with recommendations) to Commission: **Sept. 1997**
- Whether to propose rule on small open flame ignition risk
- Whether to initiate action on cigarette ignition risk

List of Tables and Figures

I. INTRODUCTION

The Federal Standard for the Flammability of Mattresses (and Mattress Pads), 16 CFR 1632, was enacted to reduce ignition of mattresses by cigarettes. All mattresses manufactured for introduction into interstate commerce after 1973 were required to conform to the standard. In addition to testing on a bare mattress, the performance tests require that the mattress and mattress pad be covered by two 100 percent cotton sheets during the test. No other bedding is present during the test.

In 1984, CPSC staff completed a special study of mattress and bedding fires.[1] At that time, cigarettes were the primary ignition source of mattress and bedding fires. Most of the mattresses involved in those fires were thought to be of pre-standard, less fire resistant, construction. Thus it was believed that as the use of pre-standard construction mattresses decreased, further decreases in the number of fires and deaths could be expected.

Since 1980, mattress/bedding fires ignited by cigarettes and other smoking material declined from about 29,800 fires to 9,300 fires in 1993, a reduction of about 70 percent. In spite of this decrease, mattresses/bedding remain one of the biggest contributors to residential fire deaths among products within the CPSC's jurisdiction.

The purposes of this study were to:

- examine factors related to continued cigarette ignition of mattress and bedding fires,
- characterize open flame-ignited mattress/bedding fires,
- identify trends in mattress/bedding fires,
- describe primary ignition factors, such as ages of persons involved in ignitions, and
- review the role of bedding in mattress/bedding fires.

II. METHODOLOGY

A. National Estimates.

Data from the National Fire Protection Association (NFPA) and the U.S. Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS), were used to develop national estimates of mattress/bedding fires and fire losses and to identify factors involved. Estimates were derived by applying proportions observed in NFIRS to aggregate national estimates from surveys conducted by the NFPA.[2] These data captured only fires attended by fire departments. National data are presented from

1980, the first year for which the NFIRS was considered fully operational in its present form, to 1993, the most recent year available.

For most data tables, ignition sources were grouped as either smoking materials, open flame, or other. Smoking materials consisted of cigarettes (primarily), cigars, and pipes. Open flame ignition sources mostly involved items such as lighters, matches, and candles. Other ignition sources included heat from fuel-fired objects, heat from electrical equipment arcing or overloaded, or heat from hot objects such as lamps.

Fire department reports specify the first material thought to have ignited in a fire, in this case either a mattress or bedding. However, the reader is cautioned about the validity of the relative proportions reported (see Appendix A). Since the mattress and bedding items were generally in close contact with each other, identification of which item ignited first was difficult. This was especially true when there was little left of the bedding or mattress and few adult witnesses to the ignition sequence, such as when the person involved was either asleep or very young. Therefore, the tables in this report combine national estimates for mattress and bedding ignitions.

The fire department decision to call a fire child play-related rather than arson-related depends upon whether the child was believed to understand that the activity could result in a damaging fire. The ages of children involved in child play fires are not well defined but are thought to involve children as old as age eleven. Ages of the fire starters are not reported in the NFIRS data.

B. Investigations

CPSC field staff investigations provided detailed information. Contacts were developed with local fire departments to arrange for rapid identification of fires that were in-scope, i.e., non-arson residential structure fires in which the material first ignited was either a mattress or bedding. In addition to the fire department contacts, other fires were identified through news reports. If the mattress and/or bedding items were still available, an on-site investigation was attempted. Otherwise, investigations were completed by telephone. Fire department reports and photographs were obtained, where available. Mattress/bedding samples were not collected but, when available, were inspected by CPSC investigators to identify characteristics of construction that indicated their relative ages. These features included surface type, material directly under the surface ticking, and condition.

For this study, 156 in-scope cases were collected between October 1994 and December 1995. In 55 cases (35%), an on-site investigation was conducted. Overall, investigators examined the mattress in 26 cases (17%). For many cases, the mattress had been discarded after the fire and was unavailable for examination. Overall, 65 occupants (42%) were interviewed. In this study, an occupant/victim who was the property owner was more likely to have been interviewed than an occupant/victim who was a renter (58% compared to 42%). Factors such as relocation, injury or death, or complete destruction of the home or the mattress often precluded an on-site visit or

response to investigators. In the cases investigated, the majority of individuals involved in the mattress/bedding fire were renters, non-owners of the fire location property (68%), and over half (55%) reported their household income as less than $15,000. As in the NFIRS data, identification of actual ignition sequence was difficult in most cases since the actual ignition sequence often was not witnessed by an adult. While these cases were not part of a sample of known probability of selection, they provided useful information on mattress/bedding fire incidents. Throughout, the reader is cautioned about reliability whenever the data subsets involved are small.

III. NATIONAL DATA

A. Estimates

As detailed in Tables 1 and 2, in 1993, mattresses and bedding were the first items ignited in an estimated 31,300 residential structure fires that resulted in 610 civilian deaths, 3,540 civilian injuries, and $385.2 million in property loss. These losses accounted for about 7 percent of all residential structure fires and 16 percent of civilian deaths and injuries that occurred in residential structure fires. Mattress/bedding ignitions were one of the major causes of residential fire deaths in 1993.

The greatest proportion of mattress and bedding fires were due to ignitions by small open flame products, an estimated 13,150 of the 31,300 fires in 1993 (42%). Child play accounted for 70 percent of all open flame fires; 9,200 fires that resulted in 180 deaths, 1,250 injuries, and $107.8 million in property loss. Most such fires occurred when children played with open flame products such as lighters or matches. Lighters were involved in about 5,000 child play fires that resulted in 90 deaths; matches were involved in about 3,700 child play fires that resulted in 60 deaths. Overall, child play was involved in 83 percent of all deaths to children less than 5 years of age and about 30 percent of all mattress/bedding fires and deaths.

Although open flame-ignited fires made up the largest portion of the mattress/bedding fires, deaths were most often attributed to fires ignited by smoking materials (cigarettes, cigars, or pipes), 340 (55%) of the 610 deaths in 1993. Mattress/bedding fires ignited by smoking materials had a higher risk of death, i.e., smoking material-ignited fires were more likely to result in a casualty. Deaths per 100 fires were highest when the mattress or bedding was ignited by smoking materials and the victim was said to be unconscious, had mental or physical impairment, or was under the influence of drugs or alcohol (23.9 deaths per 100 fires). (For all residential fires, regardless of ignition source or item first ignited, there were 0.8 deaths per 100 fires.) Most deaths caused by smoking material ignitions occurred when the materials (mostly cigarettes) were discarded or abandoned or the victim was asleep.

About 10 percent of fires were ignited by arcing or overheating of electrical equipment. Another 10 percent were ignited when hot objects such as heaters or lamps were too close to the mattress or bedding.

B. Trends

Estimated fires, deaths, and injuries, where bedding or mattresses were the first forms of material ignited, from 1980 through 1993, are presented in Table 3. Overall, reductions that occurred in mattress/bedding fires and deaths since 1980 indicate a significant downward trend. The reductions in the total number of deaths attributed to mattress/bedding fires were primarily due to the reduction in deaths in fires ignited by smoking materials (cigarettes, cigars, and pipes). Deaths where an open flame or other source ignited the bedding/mattress did not indicate a significant downward trend since 1980.[3]

The rate of casualties associated with fires ignited by smoking materials or by an open flame increased significantly over time. For smoking material-ignited fires, there were 18.8 deaths per 1,000 fires in 1980 and 36.6 in 1993. For open flame-ignited fires, there were 11.9 deaths per 1,000 fires in 1980 and 14.7 in 1993.[3] The rate of casualties associated with other ignition sources did not change significantly over time.

It is reasonable to expect that mattress fires caused by cigarettes could be affected by changes in smoking habits. From 1980 to 1993, U.S. consumption of cigarettes declined from 631.5 billion to 485 billion.[4] A test of the relationship between cigarette consumption and mattress/bedding fires found that a very close correlation existed (r_s=.98), indicating that the reductions observed in mattress/bedding fire deaths may be, in part, due to reduced cigarette consumption.[5]

The relationship, over time, of the fires and deaths by ignition source is depicted in Figures 1 and 2. Since 1980, the relative rankings of the ignition sources of mattress/bedding fires have changed. In 1980, smoking material was the ignition source in the major portion of fires and deaths. In 1993, open flame ignition sources constituted the major portion of mattress/bedding fires, rather than smoking materials as seen in earlier years. The percent reductions in fires, deaths, and injuries between 1980 and 1993 are presented in Table 4. Mattress/bedding fires decreased more rapidly than residential fires overall, a 54 percent reduction for all mattress/bedding fires compared to a 38 percent reduction for residential fires from all causes. Smoking material-ignited mattress/bedding fires accounted for the greatest change, with a 69 percent reduction during this period, while the open-flame reduction of 40 percent was similar to total residential fire reduction.

C. Fire Casualties

Deaths

The ages of the victims involved in mattress/bedding fires varied by ignition source. As detailed in Table 5, the largest proportion of deaths (26%) occurred among children less than 5 years of age, most often in open flame (e.g., lighters, matches)-ignited mattress/bedding fires. Almost 70 percent of the open flame fatalities were children less than 5 years of age. Deaths to adults of all ages were more likely to occur in smoking material-ignited fires.

The youngest and oldest individuals had the highest risks of death. This may be due to factors such as differences in abilities to respond to a fire or possibly because these two groups were more frequently involved in the ignition of the fire. For children younger than 5 years of age, the death rate per 100,000 population was 0.8. For adults 75+ years of age and older, the death rate per 100,000 population was 0.7.

Injuries

Children less than 5 years of age also had the highest risk of fire injury, 2.2 per 100,000 population. Adults between the ages of 25 and 44 had the second highest risk of injury (1.7 per 100,000 population). Adults in this age group also comprised the largest number of mattress/bedding fire injuries (38%).

D. Detector Performance

Nearly half (48%) of the mattress/bedding fires occurred in residential structures without a fire/smoke detection system. Detectors alarmed during the fire in about two-thirds (64%) of the residences where a detector was present. Since smoke detectors are by far the most common type of detectors in households, most of these detectors probably were smoke detectors, although the data did not specify type.

NATIONAL ESTIMATES OF RESIDENTIAL FIRES AND CIVILIAN CASUALTIES ASSOCIATED WITH MATTRESS/ BEDDING FIRES, BY PERCENT, 1993

Ignition Source and Ignition Factor	Fires	Deaths	Injuries
Total Mattress and Bedding Fires	31,300	610	3,540
Percent	100.0%	100.0%	100.0%
Smoking Material	29.7%	55.4%	31.6%
Discarded Material	19.7%	29.4%	18.1%
Fell Asleep	5.8%	15.7%	10.1%
Unconscious	0.4%	5.2%	0.8%
Other Ignition Factors	1.9%	5.9%	1.7%
Arson or Suspicious	1.6%	---	1.1%
Child Play	0.5%	---	---
Open Flame or Spark	42.0%	31.8%	44.7%
Children Playing	29.4%	28.8%	35.3%
Arson or Suspicious	7.7%	2.0%	6.1%
Other Ignition Factors	5.1%	1.3%	4.1%
Electrical	10.8%	5.7%	10.5%
Hot Object	10.8%	4.5%	9.6%
Fuel Fired	3.4%	0.6%	2.4%
Other Ignition Source	3.3%	1.9%	1.2%

Notes:
Smoking materials are cigarettes (primarily), cigars, and pipes.
Estimates were derived by applying proportions observed in national fire incident data (NFIRS), obtained from the U.S. Fire Administration, to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA).
Because of rounding, column detail may not add to total.

Source:
U.S. Consumer Product Safety Commission, data obtained from the National Fire Protection Association and the U.S. Fire Administration.

Tabl

National Estimates of Residential Fires and Civilian Casualties Associated with Mattress/Bedding Fires
1993

Ignition Source and Ignition Factor	Number of Fires	Number of Deaths	Number of Injuries	Property Loss (in millions)	Deaths per 100 Fires
Total Mattress and Bedding Fires	31,300	610	3,540	385.2	1.9
Smoking Material	9,300	340	1,120	101.7	<1(.6)
Discarded/Abandoned Material	6,170	180	640	72.5	2.9
Fell Asleep	1,810	100	360	16.1	5.3
Unconscious	130	30	30	2.6	23.9
Other Ignition Factors	600	40	60	4.9	6.0
Arson or Suspicious	500	-----	40	6.1	---
Child Play	150	-----	---	.9	---
Open Flame or Spark	13,150	190	1,580	150.8	<1(.2)
Child Play Lighter	5,050	90	810	64.3	
Child Play Match	3,700	60	360	37.7	1.9
Child Play Open Flame	450	30	80	5.8	
Arson or Suspicious	2,410	10	210	23.6	<1(.5)
Other Ignition Factors	1,610	10	150	19.0	<1(.5)
Electrical Equipment	3,390	30	370	49.7	1.0
Hot Object	3,390	30	340	64.3	<1(.8)
Fuel-Fired Object	1,060	3	80	7.9	<1(.4)
Other Ignition Source	1,030	10	40	10.9	1.1
All Residential Fires	**470,000**	**3,825**	**22,600**	**$4,843.0**	**.8**
Mattresses and Bedding as a Percent of All Residential Fires	6.7%	15.9%	15.7%	8%	

Notes: Smoking materials are cigarettes (primarily), cigars, and pipes. The child-play open-flame category consists of candles and open flames that were unable to be classified further. Column detail may not add to total due to rounding.

Source: U.S. Consumer Product Safety Commission, data obtained from the National Fire Protection Association and the U.S. Fire Administration.

Table 3
NATIONAL ESTIMATES OF RESIDENTIAL BEDDING/MATTRESS FIRES AND CIVILIAN CASUALTIES BY IGNITION SOURCE
1980-1993

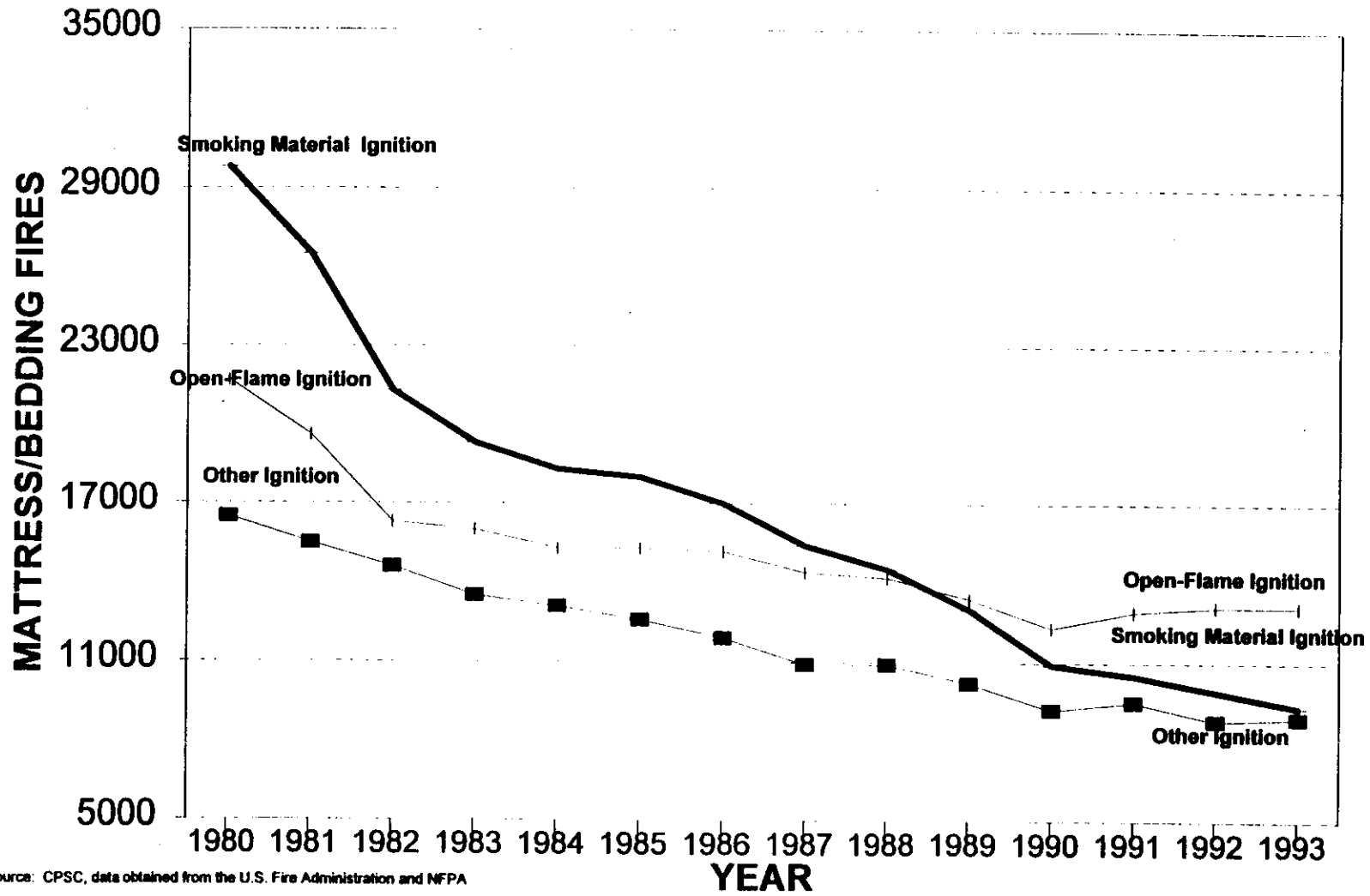
	YEAR													
	1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
						BEDDING/MATTRESS DEATHS								
Total Deaths	**980**	**920**	**730**	**720**	**710**	**910**	**790**	**760**	**940**	**690**	**640**	**640**	**650**	**610**
IGNITION SOURCE-DEATHS														
Smoking Material	560	630	500	480	390	520	420	420	500	350	330	280	320	340
Open Flame	260	150	110	120	150	210	170	210	240	180	180	200	190	190
Other	160	140	130	120	170	180	210	140	200	160	120	160	140	80
						BEDDING/MATTRESS INJURIES								
Total Injuries	**3,360**	**3,190**	**3,350**	**3,390**	**3,110**	**3,070**	**2,950**	**3,410**	**3,420**	**3,320**	**3,100**	**3,390**	**3,580**	**3,540**
IGNITION SOURCE-INJURIES														
Smoking Material	1,650	1,620	1,450	1,600	1,390	1,320	1,250	1,360	1,420	1,170	1,200	1,110	1,250	1,120
Open Flame	1,020	880	1,100	1,050	1,040	1,080	1,010	1,300	1,260	1,260	1,270	1,450	1,550	1,580
Other	690	700	790	740	680	670	690	750	740	890	630	830	780	840
						BEDDING/MATTRESS RESIDENTIAL FIRES								
Total Fires	**68,100**	**61,600**	**52,300**	**48,800**	**46,700**	**45,900**	**44,100**	**40,700**	**39,600**	**36,600**	**32,400**	**32,900**	**31,800**	**31,300**
IGNITION SOURCE-FIRES														
Smoking Material	29,800	26,500	21,300	19,300	18,300	18,000	17,000	15,400	14,500	13,000	10,900	10,500	9,900	9,300
Open Flame	21,800	19,600	16,300	16,000	15,300	15,300	15,200	14,400	14,200	13,400	12,300	12,900	13,100	13,100
Other	16,500	15,500	14,600	13,500	13,100	12,600	11,900	10,900	10,900	10,200	9,200	9,500	8,800	8,900

Notes: Smoking materials are cigarettes (primarily), cigars, and pipes. Estimates were derived by applying proportions observed in national fire incident data (NFIRS), obtained from the U.S. Fire Administration to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA). Fire estimates have been rounded to the nearest hundred, deaths and injuries to the nearest 10. Because of rounding, column detail may not add to the total. 1993 estimates were based on frequency counts of 228,497 fires, 1,905 civilian deaths, 10,471 civilian injuries and $1.935 billion in property losses.

Source: U.S. Consumer Product Safety Commission, data obtained from the U.S. Fire Administration and NFPA.

Figure 1.

RESIDENTIAL MATTRESS/BEDDING FIRES BY IGNITION SOURCE 1980-1993

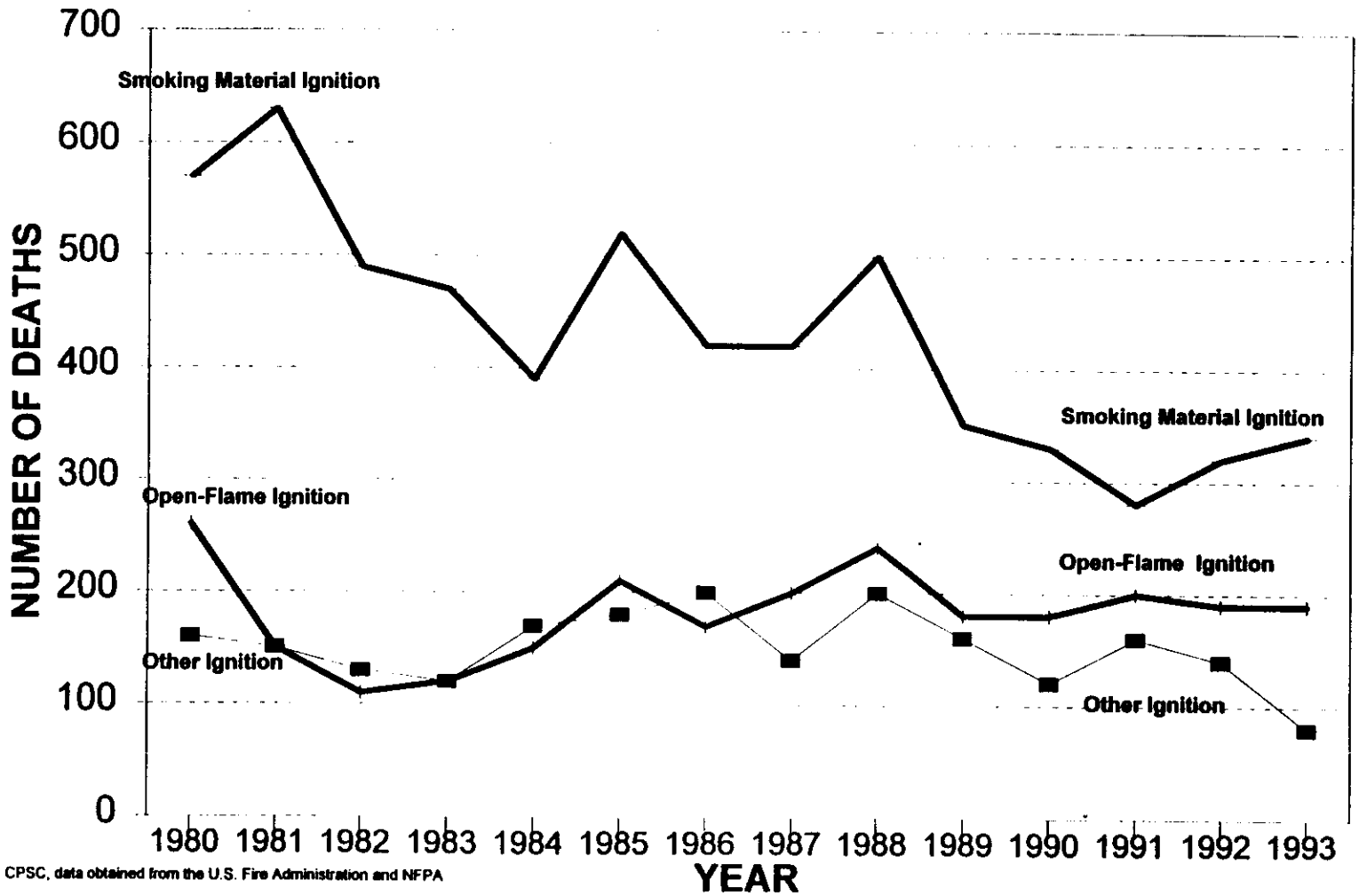


Source: CPSC, data obtained from the U.S. Fire Administration and NFPA

Note: Smoking material consists of cigarettes (primarily), cigars, and pipes. Open-flame ignition consists of lighters, matches, and candles.

Figure 2.

MATTRESS/BEDDING CIVILIAN DEATHS BY IGNITION SOURCE 1980-1993



Source: CPSC, data obtained from the U.S. Fire Administration and NFPA

Note: Smoking material consists of cigarettes (primarily), cigars, and pipes. Open-flame ignition consists of lighters, matches, and candles. Other ignition source consists of heat from fuel-powered objects, heat from electrical equipment arcing or overloaded, or heat from hot objects..

Table 4

Percent Change in Estimated Reside. Fires, Civilian Deaths and Injuries
1980 and 1993

	1980	1993	%Change
		FIRES	
Total Residential Fires	**757,500**	**470,000**	-38%
All Mattress/Bedding Fires	**68,100**	**31,300**	-54%
Smoking Material	29,800	9,300	-69%
Open Flame	21,800	13,100	-40%
Other	16,500	8,900	-46%
		DEATHS	
Total Residential Deaths	**5,500**	**3,825**	-30%
All Mattress/Bedding Deaths	**980**	**610**	-38%
Smoking Material	560	340	-39%
Open Flame	260	190	-27%
Other	160	80	-50%
		INJURIES	
Total Residential Injuries	**21,100**	**22,600**	+7%
All Mattress/Bedding Injuries	**3,360**	**3,540**	+5%
Smoking Material	1,650	1,120	-32%
Open Flame	1,020	1,580	+55%
Other	690	840	+22%

Notes:
Smoking materials are cigarettes (primarily), cigars, and pipes.
Estimates were derived by applying proportions observed in national fire incident data (NFIRS), obtained from the U.S. Fire Administration to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA).
Fire estimates have been rounded to the nearest hundred, deaths and injuries to the nearest 10. Because of rounding, column detail may not add to the total.
1993 estimates were based on frequency counts of 228,497 fires, 1,905 civilian deaths, 10,471 civilian injuries and $1.935 billion in property losses.

Source:
U.S. Consumer Product Safety Commission, data obtained from the U.S. Fire Administration and NFPA.

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Ignition Sc by Age of Victim
Estimated C...ian Deaths and Injuries, 1993

Age of Victim	IGNITION SOURCE-DEATHS			Deaths Per 100,000 Population*
	Total (%)	Smoking Material	Open Flame	Other	
Total (%)	610 (100%)	340 (55.4%)	190 (31.8%)	80 (12.7%)	.2
<5 years	150 (25.5%)	10 (2.2%)	130 (21.2%)	20 (2.9%)	.8
5-9 years	30 (5.7%)	20 (2.9%)	20 (2.9%)	4 (.7%)	.2
10-14 years	10 (1.9%)	-----	10 (1.5%)	-----	.1
15-24 years	20 (3.8%)	20 (2.9%)	4 (.7%)	-----	.1
25-44 years	110 (17.8%)	80 (13.9%)	10 (2.2%)	20 (2.9%)	.1
45-64 years	100 (16.6%)	80 (12.4%)	4 (.7%)	10 (2.2%)	.2
65-74 years	80 (12.7%)	50 (8.8%)	10 (1.5%)	10 (2.2%)	.4
75+	100 (15.9%)	70 (11.7%)	10 (1.5%)	10 (2.2%)	.7

Age of Victim	IGNITION SOURCE-INJURIES			Injuries Per 100,000 Population
	Total (%)	Smoking Material	Open Flame	Other	
Total (%)	3,540 (100%)	1,120 (31.6%)	1,580 (44.7%)	840 (23.7%)	1.4
<5 years	440 (12.4%)	50 (1.3%)	300 (8.4%)	90 (2.6%)	2.2
5-9 years	150 (4.3%)	30 (.8%)	70 (2.0%)	40 (1.2%)	.8
10-14 years	190 (5.3%	10 (.4%)	100 (2.9%)	60 (1.8%)	1.0
15-24 years	580 (16.2)	110 (3.2%)	330 (9.4%)	110 (3.0%)	1.6
25-44 years	1370 (38.6%)	480 (13.4%)	600 (17.0%)	310 (8.7%)	1.7
45-64 years	470 (13.2%)	260 (7.5%)	110 (3.2%)	80 (2.2%)	.9
65-74 years	180 (5.0%)	100 (2.8%)	40 (1.1%)	60 (1.7%)	1.0
75+	180 (5.0%)	90 (2.4%)	30 (1.0%)	80 (2.1%)	1.3

*U.S. Bureau of the Census, *Current Population Reports*, P25-917 and P25-1095; and Population Paper Listing 21.

Notes: Smoking materials are cigarettes (primarily), cigars, and pipes. Estimates were derived by applying proportions observed in national fire incident data (NFIRS), obtained from the U.S. Fire Administration to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA).
Fire estimates have been rounded to the nearest hundred, deaths and injuries to the nearest 10. Because of rounding, column detail may not add to the total. 1993 estimates were based on frequency counts of 228,497 fires, 1,905 civilian deaths, 10,471 civilian injuries and $1.935 billion in property losses.
Source: U.S. Consumer Product Safety Commission, data obtained from the U.S. Fire Administration and NFPA.

INVESTIGATIONS

A. First Item Ignited

In the 156 fires investigated by CPSC field staff, 37 reports (26% of those specifying item ignited) stated that the mattress ignited first. Bedding reportedly ignited first in 94 cases (67%). (In some instances the bedding may not have actually flamed.) As listed in Table 6, detailed information concerning the specific type of bedding often was limited. The type of bedding was specified in 38 of the 94 cases where bedding was identified as the item first ignited. Where specified, sheets most often were identified as the bedding item first ignited. The reader is cautioned on making conclusions about the relative distribution of the item first ignited because of the small sample and the difficulty in identifying the ignition sequence. Even though the occupant/victim was interviewed in 65 (42%) of the investigations, only seven adults stated that they witnessed the initial ignition.

B. Age of Mattress

Investigations were reviewed to determine the age of the mattress in terms of whether the mattress was manufactured before or after the federal standard took effect in 1973. Age was identified for 16 of the 37 mattresses reported as the first material to ignite (Table 7). Of these, 2 were believed to be manufactured before the standard, and 14 after the standard. Among the 12 mattresses ignited by a cigarette, 1 appeared to be a pre-standard mattress and 6 appeared to be ɜt-standard mattresses (which should have resisted cigarette ignition). One post-standard ɹttress was described as a futon. Mattress age could not be determined for the remaining five mattresses ignited.

Information on how the mattress was acquired was available in less than half the cases overall. The mattress reportedly was purchased new in 26 percent of the cases and obtained used in 17 percent (mostly "hand-me-downs"). For mattresses reported as having been obtained used, in most cases nothing unusual was reported about their construction. One mattress was described as "reconditioned".

C. Location of Ignition

Among the 37 investigations in which the mattress reportedly was the first item ignited, the location of ignition was identified in 16 fires. As listed in Table 8, all the incidents involving smoking materials occurred on the top surface while the open flame-ignited fires occurred at a variety of locations on the mattress.

D. Age of Person Involved in Ignition and Ignition Factors

The age of the person involved in ignition, e.g. the adult smoker or the child playing with a lighter, was identified in 124 fires (79%). As listed in Table 9, 64 of the cases (52%) identified the age of the person as less than 15 years old (32% were less than 5 years old; about 20% were 5-14 ɹrs old). As in the national estimates, child play was the single most common cause of the

ttress/bedding fires. Child play was involved in 63 investigated fires, 51 percent of those where age of the person involved in ignition was known. Of these, 31 fires involved a child under age 5 playing with a lighter, 6 of which were reportedly child-resistant lighters. (In one of these, an adult had modified the lighter so that the child-resistant feature was no longer active.) However, since the lighters were not collected, it was not possible to verify the presence/status of the child-resistant feature. Among fires ignited by children under age 5 with a lighter, most ignited bedding rather than mattresses, 26 fires versus 2 fires among those where the item ignited was reported. For virtually all of the fires started by children less than 15 years of age, the ignition of the mattress or bedding was not witnessed by an adult. When adults were involved, abandoned/discarded material or falling asleep were the most common causes of mattress/bedding fires, accounting for 35 (58%) of the fires involving adults.

E. Involvement and Performance of Detectors

In this study, most of the investigated cases reported the presence of a fire/smoke detection system (76%), either smoke detectors or a combination of smoke detector and sprinkler system. In 24 percent of the cases, it was reported that no detector was present. For those that reported a detector, 61 percent operated in the fire. When cause of failure to operate was reported, the two reasons most often given were that no battery was in the detector or the fire was too small to activate the detector.

F. Bedding Present

The total bedding present was reported in about two-thirds of the investigations. Among these cases, about half reported that more than one bedding item was present. About one-quarter of the cases reported the presence of a comforter or bedspread and in 8 percent of the cases, the comforter or bedspread was reported as the first item to ignite in the fire.

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FIRST ITEM IGNITED BY IGNITION SOURCE
SAMPLE CASES COLLECTED OCTOBER 1994-DECEMBER 1995

	IGNITION SOURCE				
	TOTAL	CIGARETTE	OPEN FLAME	OTHER	UNKNOWN
	Number	Number	Number	Number	Number
FIRST ITEM IGNITED					
Total	156	44	75	27	10
Total Unknown	15	5	5	2	3
Total Known	141	39	70	25	7
Mattress	37	12	10	8	7
Bedding	94	26	58	10	----
Comforter	5	----	4	1	----
Sheets	12	6	4	2	----
Dust Ruffle	4	3	1	----	----
Pillowcase	1	----	1	----	----
Blanket	7	1	4	2	----
Bedspread	7	1	6	----	----
Bedding Item, NS	56	15	36	5	----
Pad	2	----	2	----	----
Electric Blanket/Pad	7	----	----	7	----
Boxspring	3	1	2	----	----

Source: Investigations conducted by the U.S. Consumer Product Safety Commission October 1994-December 1995.

Table 7

IGNITION SOURCE BY AGE OF MATTRESS WHERE MATTRESS WAS THE ITEM REPORTED AS FIRST IGNITED SAMPLE CASES COLLECTED OCTOBER 1994-DECEMBER 1995

Ignition Source	Total	Age of Mattress: Pre-standard	Post-Standard	Unknown Age
Total	37	2	14	21
Unknown	7	----	1	6
Total Known	30	2	13	15
Cigarette	12	1	6	5
Open Flame	10	1	6	3
Other	8	----	1	7

Source: Investigations conducted by the U.S. Consumer Product Safety Commission October 1994-December 1995.

Table 8

LOCATION OF MATTRESS IGNITION BY IGNITION SOURCE FOR SAMPLE CASES COLLECTED FROM OCTOBER 1994-DECEMBER 1995

	IGNITION SOURCE				
LOCATION OF IGNITION	**Total**	**Cigarette**	**Open Flame**	**Other**	**Unknown**
Total	37	12	10	8	7
Unknown	21	7	3	5	6
Total Known	16	5	7	3	1
Top Surface	9	5	2	1	1
Side of Mattress	4	--	3	1	--
Underside of Mattress	3	--	2	1	--

Source: Investigations conducted by the U.S. Consumer Product Safety Commission October 1994-December 1995

AGE OF PERSON INVOLVED IN ..NITION AND IGNITION FACTOR BY SOURCE OF IGNITION FOR CASES COLLECTED OCTOBER 1994-DECEMBER 1995

Age of Person and Ignition Factor	Total	SOURCE OF IGNITION Cigarette	Open Flame	Other	Unknown
Total Known	124	34	69	18	3
<5 years of age	40		39	1	
Child Play	40		39	1	
5-14 years of age	24		20	1	3
Child Play	23		20		3
Material Too Close to Heat	1			1	
15-24 years of age	18	8	5	5	
Abandoned/Discarded Material	7	3	3	1	
Falling Asleep	5	4	1		
Electrical Failure	2			2	
Material Too Close to Heat	1			1	
Misuse of Material Ignited	1			1	
Teen Play/Teen With	1		1		
Person Impaired	1	1			
25-64 years of age	28	19	3	6	
Falling Asleep	9	8	1		
Abandoned/Discarded Material	8	7	1		
Unconscious	3	3			
Electrical Failure	3			3	
Material Too Close to Heat	2			2	
Inadequate Control of Flame	1		1		
Other Misuse	1			1	
Person Impaired	1	1			
65+ years of age	14	7	2	5	
Falling Asleep	4	3	1		
Mechanical Failure/Malfunction	4			4	
Unconscious	3	2	1		
Abandoned/Discarded Material	2	2			
Too Close to Heat	1			1	

Source: Investigations conducted by the U.S. Consumer Product Safety Commission October 1994-December 1995

V. DISCUSSION

National fire data indicate that the overall number of mattress/bedding fires and deaths decreased significantly since 1980. Most of this reduction occurred in fires involving ignition by smoking materials (primarily cigarettes), the subject of the 1973 Federal mattress standard. However, in spite of the standard and the reduction in fires and deaths, smoking-related ignitions still accounted for 9,300 (30%) mattress/bedding fires and 340 (55%) mattress/bedding deaths in 1993, exceeding deaths from open flame causes. The high rate of death in these fires reflects the prevalence of fire occurrence when people discarded their cigarettes or fell asleep while smoking.

There are several possible reasons why cigarette-ignited mattress/bedding fires continue to occur. Bedding material rather than the mattress may be the first item ignited in some fires. Data based on fire estimates indicate that mattress/bedding fires due to cigarettes first ignited the mattress about twice as often as the bedding. Although based on small numbers, data from the investigated fires in this study, including interviews with the occupants/victims, indicated the reverse--that bedding was ignited about twice as often as the mattress. Mattresses are seldom used without any bedding. When bedding other than a sheet is used (a situation not tested in the standard), it is likely that a dropped cigarette would first contact the bedding, increasing the likelihood that the bedding would ignite first.

However, in the 1984 study cited earlier, limited tests carried out with various bedding materials (sheets, blankets, bedspreads, quilts, etc.) under a variety of configurations indicated that the cigarette ignition potential of most bedding items was low. Sheets, in particular, did not ignite under test conditions. In the tests, only a 100 percent cotton quilt and a 100 percent cotton bedspread ignited, with only the 100 percent cotton quilt resulting in subsequent ignition of the (complying) mattress.[6] When this type of bedding is present, mattress fires might not be reduced by the current standard which uses only cotton sheets on a mattress during testing. Although the true proportion of mattress versus bedding as the item first ignited remains uncertain, bedding ignition is a likely factor among smoking material-ignited fires, limiting the potential effect of the mattress standard.

Other factors also could affect the continuing involvement of mattresses in cigarette-ignited fires. Some pre-standard mattresses still may be in use. The sample cases may not reflect the true proportion of pre-standard mattresses involved in cigarette-ignited fires due to the small number of mattresses for which age was determined. Also, some post-standard mattresses or refurbished mattresses may not conform to the Mattress Flammability Standard.

Compared to smoking material-ignited fires, open flame-ignited fires have not shown a significant downward trend and accounted for 13,100 (42%) of all mattress/bedding fires and 190 (33%) of all mattress/bedding fire deaths in 1993. Among the 69 open flame fires investigated by CPSC, about 45 percent were caused by children less than 5 years of age

playing with lighters. It is expected that the 1994 Safety Standard for Cigarette Lighters (16 CFR, Part 1210) will reduce this segment of mattress/bedding fires as post-standard lighters replace older lighters. However, the lighter standard will not reduce fires from other small open flame sources such as matches, candles, or lighter-ignited fires started by older children (roughly ages 5 and over). CPSC plans to conduct a special study, beginning in October 1997, to evaluate the effectiveness of the child-resistant lighter standard.

Appendix A
National Estimates of Fire Losses in Residential Structure Fires by by Form of Material Reported as First Ignited and Ignition Source, 1993

Form of Material First Ignited and Ignition Source	FIRES	DEATHS	INJURIES	PROPERTY LOSS (IN MILLIONS)
Mattress and Bedding Fire Total	31,300	610	3,540	$385.2
Mattress Total	16,930	220	1,730	$176.8
Smoking Materials	6,150	120	650	$48.2
Open Flame Ignition	6,950	70	770	$65.6
Other	3,830	30	310	$63.0
Bedding Total	14,360	390	1,810	$208.4
Smoking Materials	3,150	210	480	$53.5
Open Flame Ignition	6,190	130	810	$85.2
Other	5,020	50	530	$69.7

Notes:
Smoking materials are cigarettes (primarily), cigars, and pipes.
Estimates were derived by applying proportions observed in national fire incident data (NFIRS), obtained from the U.S. Fire Administration to aggregate national estimates from a survey conducted by the National Fire Protection Association (NFPA).
"Smoking materials" category consists primarily of cigarettes.
The reader is cautioned about the validity of the relative proportions shown for mattresses and bedding.
Fire estimates have been rounded to the nearest hundred, deaths and injuries to the nearest 10. Because of rounding, column detail may not add to the total.

Source: U.S. Consumer Product Safety Commission, data obtained from the U.S. Fire Administration and NFPA.

ENDNOTES

1. D.K. Tinsworth and S. Kelly, Fires in Mattresses and Bedding, EPHA, July 1984.

2. John R. Hall, Jr. and Beatrice Harwood, "The National Estimates Approach to U.S. Fire Statistics," Fire Technology, May 1989, Volume 25, Number 2, pp.99-113.

3. Spearman's statistic using the normal approximation in E.L. Lehmann, Nonparametrics, Holden-Day,San Francisco, 1975, pp.290-291, $p<.01$ for all significant trends.

4. Tobacco Situation and Outlook. Commercial Agricultural Division, Economic Research Service, U.S. Department of Agriculture, December 1995, TBS-233.

5. Spearman's correlation coefficient, $r=.98$, $p=.0001$.

6. L. Fansler, Memorandum to L.J. Sharman, Analysis of CPSC Bedding Fire Test Program, Part II, August 29, 1984.